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ACCOMODATING DEAF AND HARD OF HEARING PERSONS ON
PUBLIC TRANSPORTATION SYSTEMS IN MASSACHUSETTS

A Study Prepared for the
Massachusetts Executive Office of
Transportation and Construction
(Ann Hershfang, Undersecretary)
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EXECUTIVE SUMMARY

The Massachusetts Executive Office of Transportation and Construction (EOTC) commissioned this study because no definitive information presently exists to form transit policy regarding the hearing impaired. As a first step in crafting a state-wide policy, we focus on the bus and rail transit services provided by the Massachusetts Bay Transportation Authority (MBTA) and the Logan airport services provided by the Massachusetts Port Authority (Massport).

We find that the hearing impaired population in Massachusetts may be as large as 500,000. Transit agencies across the nation are growing in their awareness of the needs of the hearing impaired. Furthermore, the MBTA and Massport, in specific, have taken some concrete steps to address the needs of this population. To build on their actions, we recommend that EOTC ask for comments on the proposed requirements:

- o Prominent display of printed schedules or video monitors in transit stations where detailed bus, train and flight schedule information is needed.
 - o Electronic readerboards in transit stations to provide information of an intermittent nature. Readerboards should notify passengers of transit delays, paging, and PA announcements.
 - o Visual emergency signals inside new subway cars and the retrofitting of old cars.
 - o Sensitivity training for transit employees addressing the needs of the hearing impaired.
- Transportation planners should ensure that transit policy reflects

the needs of the hearing impaired, especially since such actions will often benefit the general population. Massachusetts has a significant foundation on which to build a model transit system for the deaf and hard of hearing.

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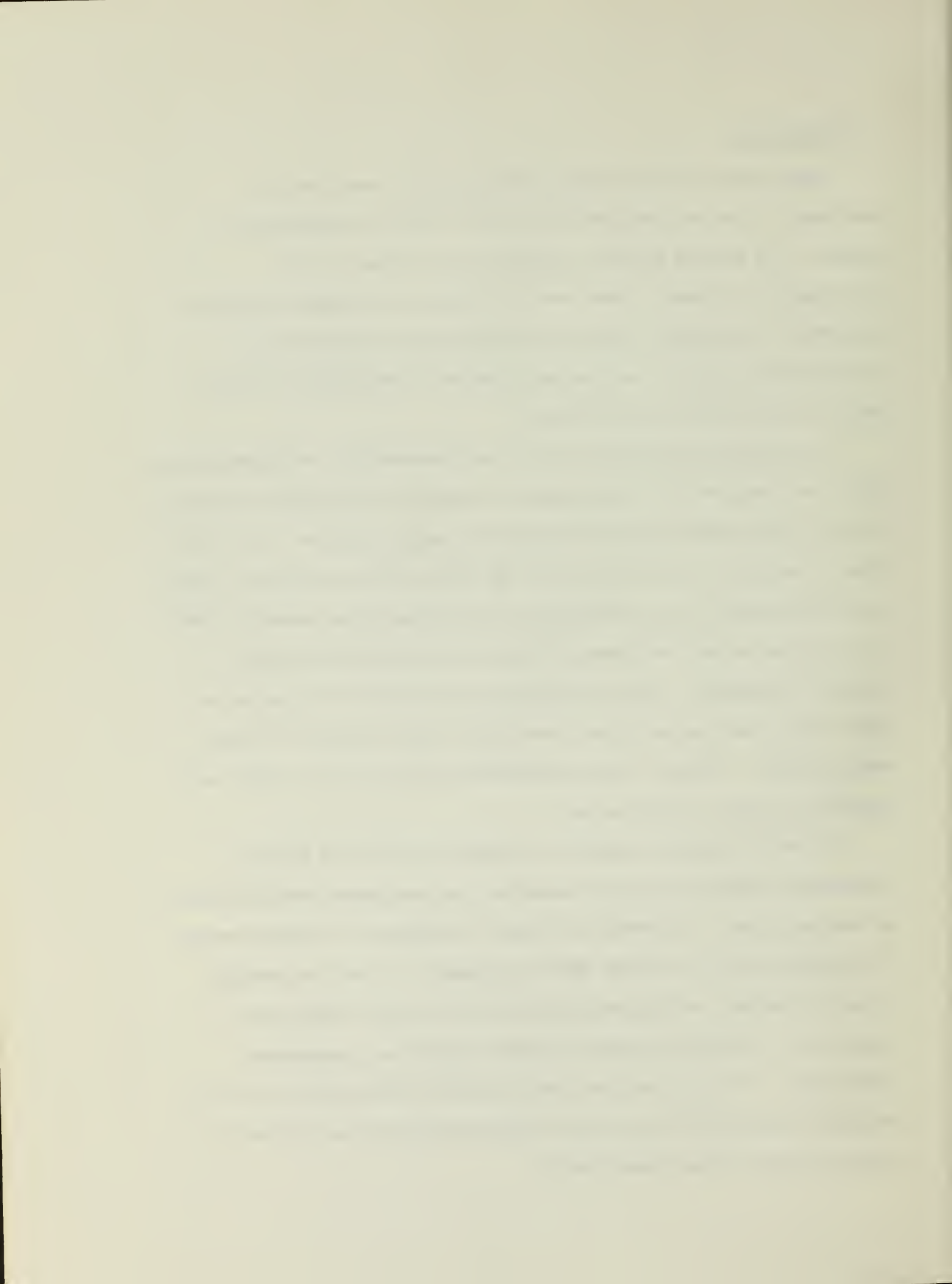
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1.0 INTRODUCTION

Approximately 500,000 Massachusetts residents have hearing impairments which can complicate their use of public transportation systems. The hearing impaired frequently lack access to oral communication on buses, subways and at airports. The result is missed connections, significant delays and increased risk in emergencies. Transportation personnel who are not prepared to communicate with the hearing impaired compound the problem.

The Massachusetts Executive Office of Transportation and Construction (EOTC) commissioned this study because no definitive information presently exists to form transit policy regarding the hearing impaired. As a first step in crafting a state-wide policy, we focus on the bus and rail transit services provided by the Massachusetts Bay Transportation Authority (MBTA) and the Logan airport services provided by the Massachusetts Port Authority (Massport). Time constraints do not permit consideration of Rapid Transit Authorities (RTAs), non-profit transit systems and water transportation. However, many recommendations specific to the MBTA and Massport may apply to them as well.

To develop a policy framework, we assess the types of problems experienced by hearing impaired people and the demographic characteristics of the population. We discuss the types of technology in current use and the present practices of EOTC, MBTA and Massport, as well as agencies across the nation. We note relevant federal and state policies and regulations. We then recommend regulatory changes and appropriate technologies. Finally, we give specific design recommendations for the MBTA and Massport which can also be applied to public bus, rail and air transit systems across Massachusetts.



2.0 PUBLIC TRANSPORTATION PROBLEMS FOR THE HEARING IMPAIRED

Hearing impaired people confront a sequence of situations in public transportation trips that pose potential difficulty. Of course, not all situations will lead to problems on every trip. Furthermore, some problems are faced by the general population. However, these are key access points for the hearing impaired:

2.1 BUS

- * They must access schedule and destination information through printed material or, if over the phone, through use of a Telecommunication Device for the Deaf (TDD).
- * Hearing impaired people must communicate with the driver either through sign language or written notes.
- * A visual STOP REQUESTED sign is necessary to alert the hearing impaired passenger that the driver has received a stop request (generally sent through a bell signal).

2.2 SUBWAY

- * The hearing impaired passenger must use signs and system maps in the terminal or on the car to know independently the correct travel route and the destination of an incoming train.
- * If questions or problems arise, the passenger must rely on transit staff who may be busy with fare lines or unable to communicate effectively with the hearing impaired.
- * When waiting for a subway train on the platform, individuals need to be aware of public address announcements regarding a change in a train's status from local to express.
- * While in the subway station, riders need to be aware of delays in service or other special circumstances so that alternate travel routes can be planned.
- * On the subway train, individuals need to be aware of voice announcements regarding upcoming station stops, especially on a crowded vehicle where the noise level is high and vision may be obstructed.
- * The hearing impaired must be aware of announcements of explanations and directions to passengers during emergencies.
- * Hearing impaired persons must rely on amplified phones or Telecommunication Devices for the Deaf (TDDs) to make outgoing phone calls.

2.3 AIRPORT

- * In parking garages, the hearing impaired need access to emergency voice boxes which can be used in cases ranging from automobile breakdown to reported theft.
- * Passengers must be aware of paging and flight announcements given both inside and outside the terminal.
- * If questions or problems arise, the passenger must rely on information personnel that may not be able to communicate effectively with the hearing impaired.
- * The hearing impaired must rely on amplified phones and Telecommunication Devices for the Deaf (TDDs) to use public telephones.
- * The hearing impaired must rely on signs to know independently where flight gates and other services are located.

3.0 THE HEARING IMPAIRED IN MASSACHUSETTS

There are many points along a typical public transportation trip where the hearing impaired face difficulty, but how many will benefit from improvements in public transportation? We answer this question by considering the demographic characteristics of the hearing impaired population in Massachusetts. We also estimate the hearing impaired users of the MBTA transit system and Logan International Airport.

3.1 Size of the Population:

In 1985, the National Center for Health Statistics estimated that 9.1% of the population, or 21.2 million people, had a hearing impairment.

(1) The hearing impaired population is defined as those persons reporting any type of hearing problem. (2)

There are 500,000 or more hearing impaired persons in Massachusetts. This estimate is found by applying the national prevalency estimate of 9.1% to the 1986 Massachusetts population. (3) The Massachusetts Commission for the Deaf and Hard of Hearing (MCDHH), however, estimates this population to be 292,740 persons as of 1985. (4) These two estimates form useful upper and lower limits on the probable hearing impaired

population. However, in a public transportation context, the higher number is most useful. Even people with minor hearing loss can have problems when using public transportation systems.

3.2 Degree of Hearing Loss

Only 10% of the hearing impaired can be considered to be severely or profoundly deaf. (5) Most of the hearing impaired population can understand some auditory messages either unaided or with hearing aids. Consequently, many could benefit from audio, as well as video, accessibility improvements.

However, we suggest that transportation planners not over emphasize the distinction between the deaf and hearing impaired. In noisy environments, the hearing impaired may become functionally deaf. Furthermore, a number of definitions of deafness exist. Nonetheless, the most common definition is the inability to detect sounds at a level of 90 decibels. (6)

3.3 Age Distribution

The prevalency of hearing impairments is much greater for the elderly than for younger segments of the population. (See Table 1) About 11 percent of the nation's population is over 65, but as many as half of all hearing impaired are over 65. (7) On the other end of the spectrum, less than 2% of all persons under the age of 18 have a hearing impairment in the U.S.

An aging population in Massachusetts would consequently mean a rapidly growing hearing impaired population. The Massachusetts Executive Office of Elder Affairs (EOEA) estimates, however, that the population of residents in the Commonwealth ages 60 and over will grow in percentage terms (18.5% in 1986 to 18.8% in 2000, but will fall in absolute terms

from 1,080,000 to 1,030,000 because there is a predicted decline in overall Massachusetts population). (8) Therefore, unless prevalency rates for hearing impairments rise in the next few decades, there is little reason to believe that the Massachusetts hearing impaired population will grow significantly in the near future. (9)

3.4 The Hearing Impaired and Other Handicapped Populations

How does the number of potential hearing impaired users compare with other special needs populations? The answer depends upon how broad a definition we use for each population. Therefore, Table 2 defines the hearing, sight, and mobility impaired populations by level of impairment. As Table 2 suggests, there is rough parity in size among the different handicapped populations, even when using various definitions. These numbers suggest that there is a significant hearing impaired population that could be assisted by minor modifications to transit systems. Transit planners should ensure that policy actions include this population as well.

4.0 HEARING IMPAIRED USERS OF THE MBTA AND LOGAN AIRPORT

Overall population information provides us with a pool of potential users of public transportation systems in Massachusetts. But, not all of the approximately 500,000 hearing impaired in Massachusetts will use public transportation systems. (10) Therefore, to make informed policy decisions, we need to consider estimates of the actual ridership that has hearing impairments.

4.1 MBTA System

There is no definitive way to state how many of the individuals using the MBTA system have hearing impairments. However, one way

to estimate hearing impaired ridership is to make the assumption that most of the system's riders will come from the Metropolitan Boston area. If we apply the top range estimate of hearing impairments (9.1%) to the Boston Primary Metropolitan Statistical Area population, we find that potentially 257,000 hearing impaired are in the MBTA service area. (11)

An even more refined way to estimate the number of hearing impaired riders of the MBTA system is to apply the range prevalency estimates for the hearing impaired in Massachusetts to everyday ridership on the system. As Table 3 suggests, we can expect a large number of daily MBTA riders to be hearing impaired. For example, approximately 4,000 deaf users may potentially use the system in a given day. To be sure, this estimate assumes that the deaf have the same ridership patterns as the general population. (12) But even if this figure is cut in half, we see that a significant number of individuals may be facing difficulties.

4.2 Logan International Airport

Deciphering hearing impaired ridership at Logan Airport poses even more difficult problems. Total passenger trips are well documented, but passengers come from all over the world. Therefore, there is really no one service area for the Airport.

Table 4 gives estimates of the potential number of hearing impaired passengers at Logan by applying the prevalency estimates from Massachusetts to overall ridership. Approximately 313 deaf passengers may use the airport in a given day. If the broadest definition of hearing impairment is used, as many as 5,805 passenger trips per day may be affected by hearing impairments.

5.0 TECHNOLOGY AND TRAINING

Four types of technologies are currently available for the hearing impaired: amplifiers and receivers; induction loops; visual displays and Telecommunication Devices for the Deaf (TDDs). Transit authorities also use sensitivity training to alert their personnel to the needs of the hearing impaired.

5.1 Amplifiers and Receivers:

Amplifiers and receivers include FM and infrared systems that convert public address announcements into FM or infrared signals. The signals are then picked up by a receiver and headphones that look somewhat like a Walkman-style stereo headset.

ADVANTAGES:

- o High quality sound.

DISADVANTAGES:

- o The systems are not designed for mass transit settings.
- o The systems require individual receivers.
- o Few people own their own receivers. (13)
- o Public use is typically limited to quiet, stationary settings such as theaters and auditoriums.
- o Renting receivers is extremely difficult in a mass transit situation.

COST:

Infrared system:	Amplifier - \$1500	Receiver - \$130 each (14)
FM system:	Amplifier - \$750	Receiver - \$77 each (15)

5.2 Induction Loops:

Induction Loops function by creating a magnetic or induction field that interacts with the telecoil in a hearing aid. The telecoil amplifies phone conversations by picking up the magnetic field of the telephone receiver. The induction loop system simply creates a magnetic field that interacts with the telecoil in a large setting. Induction loops are typically used in private homes, classrooms, and meeting rooms. For the loop To function effectively the entire circumference of the room should

be encircled. Individuals with hearing aids then simply set a switch on their hearing aids to the telecoil or T position.

ADVANTAGES:

- o No special receiver is required other than a hearing aid with a T switch.
- o The loop is easily connected to existing PA systems.
- o The system would assist those most profoundly deaf.

DISADVANTAGES:

- o Only 4% of the hearing impaired population wear hearing aids with T switches. (16)
- o Of that 4%, only a small number would remember to use the T switch in a transit situation.
- o Induction loops pick up radio transmissions. They are also disturbed by metal, electromagnetic fields and fluorescent lights.
- o Loops do not work well in buses and railcars because of the presence of metal.
- o The 600 volts in the electric third rail of subways may interfere with the induction loop.

COST:

Coil encompassing 250 square feet: \$600 (17)

5.3 Visual Displays:

5.3.1 Video Monitors:

The Metrovision company markets a video monitor system that uses 26" TV screen monitors to televise commuter rail information as well as news, sports and advertising. The system handles 40 pages of information: 20 pages of commuter rail information, 15 pages of advertising and 5 pages of news and sports. The system intermingles the different pages of text and rotates the pages on a ten minute cycle. (18)

Hi-Tech markets monitors that provide bus schedule information at remote locations. The monitors have recessed buttons on either side of the screen that permit passengers to ask questions of the system. The information can be updated either manually by inserting new computer chips or automatically over dedicated telephone lines. (19)

ADVANTAGES:

- o Metrovision installs and operates the monitors free of charge to the transit authority if there is sufficient traffic through a station.
- o The computer instantly updates information systemwide or at selected monitors.
- o Both deaf and non-deaf people can use the information.

DISADVANTAGES:

- o Monitor screens must be large to be read from a distance.
- o Operations personnel are often reluctant to update systems continuously.
- o People may not be attracted to screens with stationary graphics. They often prefer to look down the tracks to wait for the train.
- o Advertisers may be reluctant to use a new technology, especially if the cost of advertising is expensive.

COST:

Metrovision: Free if there is sufficient passenger traffic; it can also be rented or purchased. Cost varies according to client's design requirements. (20)

Hi-tech: \$3500 per unit, plus operating costs. (21)

5.3.2 Electronic Readerboards

These are digital or Liquid Electronic Display (LED) signs which scroll messages across a screen somewhat like the Times Square sign in New York City. The oldest readerboards are self-contained and have as many as 16 computer chips, each programmed with a specific one sentence message. Updating messages is time consuming since the chip must be manually removed from the board, reprogrammed at a computer terminal and then re-inserted.

The best example of a computer controlled readerboard system is that installed in San Francisco's Bay Area Rapid Transit (BART) stations by the Stewart Warner Company. The system uses 156 readerboards controlled by a 1969 Digital Equipment computer. Each readerboard displays the time, the arrival time of the next train, train delay messages, public service announcements, advertisements and news information. Messages can be sent system-wide or to selected readerboards. The system was designed to allow use by 4 advertisers, BART and one TV or radio station. Two 5' by 16" readerboards are on each of the two platforms of the 34 stations of the

BART system.

The Silent Radio Company also markets an electronically controlled readerboard system that would permit updates by radio. Such a system permits the use of readouts inside individual subway cars as well as on station platforms.

In 1987 BART's Safety Department studied the use of such readerboards on subway cars, but found that it would not be cost effective from strictly a safety standpoint. It would have cost \$2.0 million dollars to equip the cars of 47 trains with readerboards that from a safety standpoint would be used for only a few minutes at most. BART also discovered operational issues. These ranged from whether the train operator or the central dispatch controller should have responsibility for sending messages on the subway readerboards to juggling 47 different radio frequencies for 47 different trains. (22)

A subway car readerboard system is workable but BART did not consider it justifiable if safety was the only criteria. The value of transmitting information such as upcoming stops and train delays to passengers was not considered in the decision.

ADVANTAGES:

- o A computer can instantly update information and send it system-wide or to selected readerboards.
- o Both deaf and non-deaf people can benefit from the information.

DISADVANTAGES:

- o Readerboards with incandescent bulbs are energy intensive and have high maintenance costs.
- o LED readerboards can be difficult to read from an angle.

COST:

BART system: Cost unknown. A double-sided sign is 5 feet long and 16 inches high. The system requires a central computer and software. Operating costs are undetermined. (23)
Toronto system: Approximately \$2100 (US) for a single-sided LED

screen 8 feet long with letters 7 inches high. The system requires a PC computer and software. Dedicated phone lines may also be required. Operating costs are undetermined. (24)

Silent Radio system: Cost variable according to client's design requirements. (25)

5.4 Telecommunication Devices for the Deaf (TDDs) and Phone Amplifiers:

TDDs are devices that resemble small typewriters with a small screen or printer which allow a deaf individual to make a telephone call. It eliminates the need for an interpreter but it does require that another TDD be used at the receiving end. TDDs have decreased significantly in cost from about \$400 4 years ago to \$160 in 1988. According to the Telecommunications for the Deaf, Inc, in Washington, D.C., there are 200,000 TDDs in use nationwide, and the number is increasing at an annual rate of 10-20%. (26)

Phone amplifiers are used to increase the volume of public pay phones. They are typically placed in the phone receivers but recent attempts to vandal-proof the phones have resulted in their placement in the body of the phone.

ADVANTAGES:

- o Cost is relatively low and falling.
- o The use of both TDDs and amplifiers is expanding so people are becoming more familiar with them.

DISADVANTAGES:

- o Precautions have to be taken to avoid vandalism.

COST:

- TDD/TTYs: \$160 per unit (27)
- Amplifiers: \$23 per unit (28)

5.5 Sensitivity Training:

Transit authorities provide a general orientation to new employees which usually just includes information on how to deal with the physically handicapped. Some transit authorities also discuss the needs of the

1. The first part of the document discusses the importance of maintaining accurate records of all transactions and activities. It emphasizes the need for transparency and accountability in financial reporting.

2. The second part of the document outlines the various methods and techniques used to collect and analyze data. It includes a detailed description of the experimental procedures and the statistical analysis performed.

3. The third part of the document presents the results of the study. It includes a series of tables and graphs that illustrate the findings of the research. The data shows a clear trend of increasing activity over time.

4. The fourth part of the document discusses the implications of the findings. It suggests that the results have significant implications for the field of study and may lead to further research in this area.

5. The fifth part of the document concludes the study. It summarizes the main findings and provides a final statement on the importance of the research.

hearing impaired. The Toronto Transit Commission uses a film and booklet called "Touchdown" and San Francisco's BART system provides personnel with a short manual explaining how to sign important messages. A few transit authorities provide optional annual refresher courses.

ADVANTAGES:

- o Sensitivity training enables transit personnel to deal effectively with the hearing impaired.

DISADVANTAGES:

- o A one time orientation is quickly forgotten.
- o Written information is frequently not read or retained.

COST:

Printing costs for brochures; purchase costs for video tapes; cost of instructors; lost opportunity cost for workers away from their jobs.

6.0 PRESENT POLICY AND REGULATIONS

Few Massachusetts laws, regulations, or policies specifically address the transportation needs of the hearing impaired. In 1987, the Governor's Commission on Accessible Transportation detailed those non-discrimination statutes which are generally applicable. (29)

6.1 State Laws:

The relevant state laws are: Article 114 of the Massachusetts Constitution which prohibits discrimination on the basis of handicap; The Public Accommodations Law (M.G.L. Chapter 272, Section 98) which prohibits discrimination in places of public accommodation; and The Architectural Barriers Law (M.G.L. Chapter 22, Section 13A which requires full access to any public building constructed after 1975, unless a waiver is sought and granted from an "Architectural Barriers Board."

In addition to these laws, Governor Dukakis signed Executive Order 246 in 1984 which states that non-discrimination and equal opportunity is the policy of the Executive Department of the Commonwealth in all

decisions, programs and activities.

6.2 Massachusetts Transit Agency Policies and Regulations:

Few transit policies or regulations specifically deal with the hearing impaired. Hearing impaired issues are usually only addressed in the context of complying with Section 504 of the Federal Rehabilitation Law of 1973.

6.2.1 MBTA - In June 1987, the MBTA issued its MBTA Policy Statement on Special Needs Accessibility. (30) The statement outlines overall policy of the MBTA for handicapped accessibility and sets current and future goals. The policy statement identifies issues of concern to the hearing impaired such as accessibility to system and service information and visual express and stop announcements.

6.2.2 MASSPORT - In July 1987, Massport issued the study Pathways: Helping Elderly and Disabled People Get Around Logan Airport. (31) Adaptive Environments Center, the consulting firm which did the study, documented specific sites where there are accessibility needs at Logan International Airport for the elderly and disabled. They also made recommendations for the hearing impaired. Although not a policy statement, this study is Massport's central document for addressing hearing impaired issues.

6.3 Federal Laws:

Section 504 of the Federal Rehabilitation Act of 1973 must also be mentioned in any discussion of access laws. This federal law provides that "no otherwise qualified handicapped individual...shall, solely by reason of his [or her] handicap, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving federal financial assistance." Section 504

The first part of the paper discusses the importance of the study and the objectives of the research. It highlights the need for a comprehensive understanding of the subject matter and the role of the researcher in this process. The second part of the paper presents the methodology used in the study, including the selection of the sample and the data collection techniques. The third part of the paper discusses the results of the study and the conclusions drawn from the data. The fourth part of the paper discusses the implications of the study and the future research in this area. The fifth part of the paper discusses the limitations of the study and the strengths of the research. The sixth part of the paper discusses the contributions of the study to the field of research. The seventh part of the paper discusses the ethical considerations of the study and the role of the researcher in this process. The eighth part of the paper discusses the funding of the study and the role of the sponsor in this process. The ninth part of the paper discusses the acknowledgments of the study and the role of the participants in this process. The tenth part of the paper discusses the references of the study and the role of the literature in this process. The eleventh part of the paper discusses the appendices of the study and the role of the data in this process. The twelfth part of the paper discusses the index of the study and the role of the reader in this process. The thirteenth part of the paper discusses the glossary of the study and the role of the terms in this process. The fourteenth part of the paper discusses the bibliography of the study and the role of the sources in this process. The fifteenth part of the paper discusses the conclusion of the study and the role of the researcher in this process.

applies to programs which receive federal funds. (Access to Transportation, p. 6)

6.4 Federal Policies and Regulations:

On November 10, 1987, the Federal Department of Transportation (DOT) issued Notice 87-19 (52 Fed. Reg. 36803). This notice was a request for comments on the need for regulations to assure accommodations to meet the needs of the mentally impaired as well as the hearing impaired on mass transit services. The time for comments closed December 31, 1987 and the Department is still reviewing public comments. No immediate action on the part of the Department is expected.

7.0 PRESENT PRACTICE OF TRANSIT AGENCIES IN MASSACHUSETTS

7.1 EOTC: As a supervisory agency, EOTC does not provide direct transit services to the public, but it has acquired a TDD that permits hearing impaired persons to call the agency.

7.2 MBTA: The MBTA is in the process of implementing the goals identified in its MBTA Policy Statement on Special Needs Accessibility. The MBTA has taken the following actions related to the needs of the hearing impaired:

7.2.1 INFORMATION

- o Information booth - is located in Park street station.
- o Bus and transit schedules - are distributed to libraries, town halls, stores and numerous other locations.
- o Signage and Informational Graphics Project - is being conducted by the August Associates consulting firm. The study was commissioned in April 1986 by the MBTA Board of Directors. The project will include recommendations concerning measures to aid the hearing impaired. The MBTA will then review the recommendations for appropriate implementation. (MBTA Policy Statement, pp. 29 and 37) The August Associates study is not finished and no release date is set.
- o Electronic Signage Committee - was created within the MBTA approximately 6 months ago and has met 4-5 times. The committee is evaluating the performance of the video monitor at Harvard station and the readerboard at Park Street station. The committee is at a preliminary stage and is reviewing available technologies. Mr. Tom

McColl, Asst. Director of Marketing for the MBTA, chairs the committee.

- o Auditory and Visually Impaired Subcommittee of the MBTA Access Advisory Board - is composed of representatives of the auditory and visually impaired communities and relevant state agencies. The subcommittee meets monthly with staff members from the MBTA Office for Special Needs to discuss issues of concern. Ms. Denise Karuth of the Office of Handicapped Affairs chairs the subcommittee.

7.2.2 SYSTEM USE

- o Fare reductions - are available to the profoundly deaf. They pay 10 cent fares on all regular trips (as opposed to 60 cents) and half fare on all other trips. The number of people holding reduced fare cards is not available, but the Office for Reduced Fares is entering all applications into a computer system. The total number of people who hold reduced fare passes due to legal deafness will be available in July 1988. (32)
- o Transit personnel - receive a general orientation on how to deal with the handicapped when hired and an annual review. Hearing impaired issues are covered in these sessions.

7.2.3 TELEPHONES

- o TDD phone numbers - are available to the public. MBTA Route and Schedule information can be reached at (617) 722-5146 (TDD). MBTA Office for Special Needs can be reached at (617) 722-5415 (TDD). These numbers are publicized in all TV, radio and PSA announcements made by the MBTA. All companies which provide rides for the Ride Program are also required to have TDD numbers accessible to clients.
- o TDD units - 7 have been purchased by the MBTA for \$1130 and will be installed in 6 rapid transit stations so that the public can make outgoing calls by the end of June 1988. One of the seven will be placed at Central Control to answer calls for The Ride program.
- o Amplified telephones - are present in transit stations, but accessibility is inconsistent. The MBTA is working with Massachusetts Commission on Deaf and Hard of Hearing to insure that all phone banks have the appropriate number of amplified phones.

7.3 Massport: Massport is in the process of implementing the recommendations made by the Adaptive Environments Center in the July 1987 Pathways study. Implementation in some cases is complicated because while Massport owns all terminals, it only manages Terminals C and E. Terminals A and B are leased and managed by Eastern and the South Terminal Corporation respectively. (Problem numbers are from the Pathways study.)

7.3.1 INFORMATION AND COMMUNICATION

- o Information booths - are now located in the lower levels of Terminals A, C and D. No information booth is located in Terminal B. (Problem 101)
- o Information personnel - receive a general orientation on how to provide information to the public. Other than instruction on how to use the new TDD, no training is given on how to deal with the disabled or hard of hearing.
- o Paging and flight announcements - are not available on TV monitors or readerboards either inside or outside the terminal for the hard of hearing. (Problem 1)
- o Signs - at entry doors reading NO DOGS ALLOWED do not address seeing eye and hearing ear dogs. The words EXCEPT SEEING EYE AND HEARING-EAR DOGS are not posted. (Problem 54)

7.3.2 EMERGENCY CALL BOXES

- o Signs - are not yet posted next to the emergency call boxes which would indicate where the closest information desk and TDD unit can be found. (Problems 31, 60, 95, 108)

7.3.3 TELEPHONES

- o TDD - one is located at the information booth in Terminal C on a trial basis. The recommendation is that at least one be placed on each level of every terminal with numerous signs. Signs indicating the location of the TDD unit are still going up. (Problems 6, 19, 47, 51, 72, 79, 86, 102, 139)
- o Amplified telephones - accessibility is inconsistent. New banks of phones within Terminal C have 2 well-marked amplified phones for every bank of 12. However, phones in gate areas and other terminals are often not accessible. (Problem 6)

8.0 POLICY AND PRACTICE IN OTHER STATES

8.1 TRANSIT AUTHORITIES: In July 1987, Dr. Toby Pearlstein, the Chief Librarian for the State Transportation Library, conducted a survey for Dr. Katherine Seelman of the Massachusetts Commission for the Deaf and Hard of Hearing. Dr. Pearlstein wrote 47 transit authorities across the United States and in selected foreign countries to determine how they were meeting the needs of the hearing impaired. Thirteen authorities responded to the Pearlstein/Seelman survey. We contacted most of the 13 by phone as well as 4 additional transit agencies. The 17 transit authorities contacted in total are:

Austin, TX:	Capitol Metropolitan Transportation
Baltimore, MD:	Mass Transit Administration
Boston, MA:	Massachusetts Bay Area Transit
Brockton, MA:	Brockton Area Transit
Chicago, IL:	Chicago Transit Authority
Denver, CO:	Regional Transportation District
Detroit, MI:	Department of Transportation
Los Angeles, CA:	Southern California Rapid Transit District
Madison, WI:	Madison Metro
Miami, FL:	Metropolitan Dade County Transit Agency
New York, NY:	Metropolitan Transportation Authority
Oakland, CA:	San Francisco Bay Area Rapid Transit
Philadelphia, PA:	Southeastern Pennsylvannia Transportation Authority
Pittsburgh, PA:	Port Authority of Alleghany County
Sacramento, CA:	Regional Transit
Toronto, Canada:	Toronto Transit Commission
Washington, D.C.:	Washington Metropolitan Area Transit Authority

The numbers of transit authorities that provide some type of service to the hearing impaired are:

1. AMPLIFIERS AND RECEIVERS	-	0
2. INDUCTION LOOPS	-	0
3. VISUAL DISPLAYS		
a. Video Monitors	-	4
b. Electronic Readerboards	-	5
4. TDDs		
a. Information numbers	-	16
b. TDD units	-	5
5. SENSITIVITY TRAINING	-	14

Other innovative ideas used in Washington, D.C. are lights along the platform that signal an oncoming train and visual emergency signals inside subway cars.

8.2 AIRPORTS:

Six major U.S. airports were also contacted by phone and Logan was visited in person:

Atlanta, GA:	Hartsfield Atlanta International Airport
Boston, MA:	Logan International Airport
Chicago, IL:	Chicago O'Hare International Airport
Dallas, TX:	Dallas/Fort Worth Regional Airport
Los Angeles, CA:	Los Angeles International Airport
New York, NY:	John F. Kennedy International Airport
Washington, D.C.:	Washington National Airport

The number of airports that provide some type of service to the hearing impaired are:

1. AMPLIFIERS AND RECEIVERS	-	0
2. INDUCTION LOOPS	-	0
3. VISUAL DISPLAYS		
a. Paging Monitors	-	0
b. Electronic Readerboards	-	0
4. TDDs		
a. Information numbers	-	4
b. TDD units	-	7
5. SENSITIVITY TRAINING	-	2

Points worth noting are that none of the airports has solved the complex problem of providing visual paging announcements. In the case of Los Angeles and Washington's National Airport, TDDs units have been in place since at least 1982. Furthermore, sensitivity training is usually limited to a one time instruction in how to use a TDD. Essentially, no time is spent explaining how deaf people can be assisted.

9.0 RECOMMENDED POLICIES AND PRACTICES

The special needs of the hearing impaired population has only recently come to the attention of transit agencies. Until the past few years most transit agencies have focused attention on the blind and mobility disabled. However, the creation of the Massachusetts Commission for the Deaf and Hard of Hearing in 1986 signals a heightened awareness of the concerns of the deaf and hard of hearing in Massachusetts. Further, our review of the characteristics of the hearing impaired population reveals that it is comparable in size to other handicapped populations. The problems which they may encounter on public transit systems range from the inconvenience of not hearing train delay information to the hazard of not hearing emergency announcements. Since 9% of the population has hearing impairments that range from mild to severe, we recommend that the

Commonwealth of Massachusetts adopt formal policies and practices to meet their transportation needs. Accurate and accessible transit information would also be a major benefit to the general public.

9.1 RECOMMENDED REGULATIONS

9.1.1 EOTC:

EOTC should ask for comments on regulations requiring:

- o Prominent display of printed schedules or video monitors in transit stations where detailed bus, train and flight schedule information is needed.
- o Electronic readerboards in transit stations to provide information of an intermittent nature. Readerboards should notify passengers of transit delays, paging, and PA announcements.
- o Visual emergency signals inside new subway cars and the retrofitting of old cars.
- o Sensitivity training for transit employees addressing the needs of the hearing impaired.

9.1.2 Architectural Access Board:

The AAB should ask for comments on regulations that require:

- o Electronic readerboards in new public buildings in which frequent paging and public announcements are made. Old public buildings should be provided with readerboards when they are renovated.
- o Visual emergency signals in new public buildings and in renovated buildings.

9.2 RECOMMENDED PRACTICES

9.2.1 ACCURATE SIGNS AND PRINTED SCHEDULES - Hearing impaired people are more dependent than the general public on printed information. Signs and schedules should thus be available in adequate number. Since asking for clarifications is complicated by deafness, the accuracy of signs and schedules is essential.

9.2.2 READERBOARDS/MONITORS - Electronic readerboards are the best means of providing access to infrequent verbal information such as PA, train

delay and paging announcements. LED readerboard systems are preferable to incandescent digital readouts because of their lower energy and maintenance costs. When detailed bus, train or flight schedules must be continually available, video monitors are the preferred system.

9.2.3 EMERGENCY SIGNALS - Since audio alarms are ineffective for the deaf, emergencies require visual alarms. Fire lights are common in new transit stations and air terminals, but retrofitting should be done where possible. Subway cars should also have a visual emergency signal.

9.2.4 SENSITIVITY TRAINING - Not all information can be provided by signs, visual displays and emergency signals, therefore transit personnel need to be trained to communicate with the hearing impaired. Such training should be part of a new employee's orientation and be repeated periodically, if not annually. Training should ideally be conducted by people who are hearing impaired themselves. The Toronto Transit Commission's "Touchdown" booklet and video provides excellent orientation material covering the concerns of many special needs populations.

Ticket booth people and those at information desks should also have short manuals or laminated cards describing the most essential sign language phrases. A model is the manual used by the San Francisco BART system.

9.2.5 TDDS/AMPLIFIED PHONES - Schedule and transit information is generally available to the hearing impaired via TDD. However, TDD numbers should also be widely publicized among the hearing impaired population.

Steps are being taken to install TDD units in subway stations and air terminals. We support these measures and since the cost of TDD units has fallen significantly, we believe that they should be expanded.

The cost of amplifying devices on public pay phones has also dramatically declined from \$33 to \$23 per unit. Relevant federal regulations related to placement of amplified phones should be complied with.

10.0 COMMENTS ON OTHER PRACTICES

10.1 FM AND INFRARED AMPLIFICATION SYSTEMS

While FM and Infrared amplification systems can be of significant help to the hearing impaired, we do not recommend FM and infrared amplification systems for use in mass transit systems at this time. FM and infrared systems require the use of receivers. It is simply not feasible to rent such devices for use in a mass transit setting.

10.2 INDUCTION LOOPS

We do not recommend induction loops for public transit use either in vehicles or buildings. Metal in vehicles, electromagnetic fields and the extensive use of fluorescent lights in buildings makes the use of loops impractical in transit settings. The interference of radio transmissions and the fact only 4% of the hearing impaired population wears hearing aids compatible with loops add significant disadvantages better avoided by other technologies.

10.3 ELECTRONIC READERBOARDS INSIDE SUBWAY CARS

We also do not recommend placing readerboards inside subway cars. The technology is available, but safety concerns do not justify the expense according to the San Francisco BART study. Emergency warning lights which are well labeled are a better safety solution.

BART did not consider the information value of such readerboards in its study. However, destination information can be more cheaply supplied using system maps inside the cars in combination with station signs on the

platforms. Delay information would not be available once one was inside the subway car, but such information is only infrequently needed inside the car.

A bigger problem is that visual notice that the train was changing from local to express would not be available once people are inside the subway car. However, since most local to express changes occur during peak commuter hours, the crowd in the cars would obstruct view of the interior readerboards no matter where they were placed. The expense of inside readerboards is thus hard to justify. Platform readerboards at least partially solve the local to express problem.

10.4 VIDEO MONITORS

Because highly visible information is particularly important to the hard of hearing, we have serious reservations about the usefulness of monitors to the deaf and hard of hearing in subway stations. Monitors are particularly useful when schedule information is detailed and fairly constant such as at airports and train stations. However, visibility is a key criterion in subway settings when information such as the changing of a train from local to express must be flashed to people scattered on a platform. The letter size on monitors is small when compared to the standard 7" size possible on readerboards. Thus, on the basis of visibility, we recommend the use of readerboards in subways.

11.0 SPECIFIC SYSTEM DESIGN RECOMMENDATIONS

11.1 MBTA:

The MBTA is working to carry out the goals of the 1987 MBTA Policy Statement on Special Needs Accessibility. Progress at key points is noted

along with recommendations of our own. To provide model hearing impaired access on bus and rail lines the MBTA should provide:

11.1.1 BUS SYSTEM

- o Prominent and accurate station signs. The August Associates study should provide specific recommendations as to locations that need to be upgraded.
- o Printed bus schedules. A major effort is made to distribute printed schedules to the public. A full review of the effectiveness of this distribution is beyond the scope of this study, but considering the importance of printed information to the hearing impaired, the MBTA should continue to review its distribution program periodically.
- o Schedule and routing information over TDDS. TDD numbers are well advertised in accordance with the Policy Statement.
- o Touch screen video monitors. The MBTA should investigate the advantages of placing them at central stations to provide schedule and routing information. A model is the vandal-proof system used by the Los Angeles RTD and supplied by the Hi-Tech Company.
- o Bus notification slips. The London and Bristol, England bus systems provide the hearing and visually impaired with colored slips of paper on which to write their destination and give to the driver. The driver then knows when to signal an impaired person to dismount at a destination or transfer point. The MBTA should consult with the Auditory and Visually Impaired Subcommittee of the MBTA's Access Advisory Committee to explore the effectiveness of such a system. (33)
- o Lighted STOP REQUESTED signs. New buses should have these lighted signs placed at the front of the bus so that passengers will know that the driver is aware of a requested stop.
- o Sensitivity training. The MBTA is committed to regular training programs and we encourage the MBTA to continue to seek input from the MCDHH and other organizations such as Self-Help for the Hard of Hearing in planning its sensitivity training programs.

11.1.2 RAIL SYSTEMS

- o Prominent and accurate station signs and system maps. The August Associates study should provide detailed recommendations as to locations that need to be upgraded.
- o Printed system maps. These should be conveniently available at transit stations and information booths.

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- o Schedule and routing information over TDDs. TDD numbers are well advertised in accordance with the Policy Statement.
- o Electronic readerboards. The MBTA's Electronic Signage Committee is studying alternative systems. We recommend that this committee carefully consider the needs of the hearing impaired. If further study indicates that readerboards are feasible, we urge that the MBTA install readerboards. These should first be placed in stations with heavy traffic and used most frequently by the greatest numbers of hearing impaired. The system should permit automatic information updating such as that in the BART system to minimize the amount of human involvement programming messages.
- o Visual emergency signals. These should be all new subway cars and retrofitted in old subway cars. Visual fire alarms should also be present in all stations.
- o Sensitivity training. The MBTA is committed to regular training programs and we encourage the MBTA to continue to seek input from the MCDHH and other organizations such as Self-Help for the Hard of Hearing in planning its sensitivity training programs.
- o TDD units and amplified phones. TDDs are being installed in 6 stations and central control. Although the cost of the TDDs themselves is quite low (\$170 each) it appears that installation of all units will cost \$14,000. (34) We encourage the MBTA to investigate all possible means of reducing the cost so that their use can be expanded in the future. 50 amplified phones are currently in MBTA facilities. The MBTA should ensure that this number complies with federal regulations.

11.2 MASSPORT:

The Massport is working to meet the recommendations of the Pathways study. Progress to date is noted under the categories of the study along with recommendations of our own. To provide model hearing impaired access at Logan, Massport should provide:

11.2.1 INFORMATION AND COMMUNICATION:

- o Information booth at Terminal B. Massport should negotiate with the South Terminal Corp. to place an information booth in Terminal B. (Problem 101)
- o Video Monitors for paging announcements. Paging and voice flight announcements could be placed on monitors next to the flight monitors in the central terminals. The paging monitors should have adequate signs. (Problem 1) (35)

The first part of the paper is devoted to a discussion of the general principles of the theory of the structure of the atom. It is shown that the structure of the atom is determined by the laws of quantum mechanics, and that the laws of quantum mechanics are determined by the laws of the theory of the structure of the atom. This is a circular argument, but it is the only way to proceed.

The second part of the paper is devoted to a discussion of the general principles of the theory of the structure of the atom. It is shown that the structure of the atom is determined by the laws of quantum mechanics, and that the laws of quantum mechanics are determined by the laws of the theory of the structure of the atom. This is a circular argument, but it is the only way to proceed.

The third part of the paper is devoted to a discussion of the general principles of the theory of the structure of the atom. It is shown that the structure of the atom is determined by the laws of quantum mechanics, and that the laws of quantum mechanics are determined by the laws of the theory of the structure of the atom. This is a circular argument, but it is the only way to proceed.

The fourth part of the paper is devoted to a discussion of the general principles of the theory of the structure of the atom. It is shown that the structure of the atom is determined by the laws of quantum mechanics, and that the laws of quantum mechanics are determined by the laws of the theory of the structure of the atom. This is a circular argument, but it is the only way to proceed.

The fifth part of the paper is devoted to a discussion of the general principles of the theory of the structure of the atom. It is shown that the structure of the atom is determined by the laws of quantum mechanics, and that the laws of quantum mechanics are determined by the laws of the theory of the structure of the atom. This is a circular argument, but it is the only way to proceed.

- o Hearing-ear dog signs. Current signs at entry doors reading NO DOGS ALLOWED do not address seeing eye and hearing ear dogs. The words EXCEPT SEEING EYE AND HEARING-EAR DOGS are not yet up. (Problem 54)
- o Sensitivity training. Training should be periodic, if not annual, for information booth personnel using hearing impaired instructors from MCDHH and other organizations like Self-Help for the Hard of Hearing. On-the-job-training results in the best retention, so hearing impaired instructors should simply show up at the information desks and ask to be helped.

11.2.2 EMERGENCY CALL BOXES

- o Information signs. These should be posted next to the emergency call boxes indicating where the closest information desk and TDD unit is. (Problems 31, 60, 95, 108)

11.2.3 TELEPHONES

- o TDD units. One is now located at the information booth in Terminal C on a trial basis. The Pathways study recommends that at least one be placed on each level of every terminal with numerous signs. Signs indicating the location of the TDD unit are still going up. (Problems 6, 19, 47, 51, 72, 79, 86, 102, 139)
- o Amplified telephones. Accessibility is inconsistent. New banks of phones within Terminal C have 2 well-marked amplified phones for every bank of 12. However, phones in gate areas and other terminals are often not accessible. Massport should ensure that the number of amplified phones complies with federal regulations. (Problem 6)

12.0 CONCLUSION

We recognize that not all of our recommendations can be implemented immediately. However, four points underlie our recommendations:.

- o At least nine percent of the population is heavily dependent on visual information.
- o Wherever hearing people listen, hearing impaired people must read.
- o Emergency alarms for the deaf must be visual.
- o Educated transit personnel are the best and final alternative when technology fails.

The first part of the paper discusses the importance of the study and the objectives of the research. It also mentions the scope of the study and the limitations.

The second part of the paper discusses the methodology used in the study. It includes a description of the sample, the data collection methods, and the statistical analysis.

The third part of the paper discusses the results of the study. It includes a description of the findings and a discussion of their implications.

The fourth part of the paper discusses the conclusions of the study. It includes a summary of the findings and a discussion of the implications for future research.

The fifth part of the paper discusses the limitations of the study. It includes a discussion of the strengths and weaknesses of the study and the implications for future research.

The sixth part of the paper discusses the implications of the study. It includes a discussion of the implications for practice and policy and the implications for future research.

The seventh part of the paper discusses the conclusions of the study. It includes a summary of the findings and a discussion of the implications for future research.

The eighth part of the paper discusses the limitations of the study. It includes a discussion of the strengths and weaknesses of the study and the implications for future research.

The 500,000 Massachusetts residents who have hearing impairments depend on EOTC to ensure that future transit planning efforts in the state include their needs. The activities of the MBTA and Massport demonstrate that a substantial framework exists in Massachusetts to continue building a model transit system for the deaf and hard of hearing.

ENDNOTES

1. David Hotchkiss, Demographic Aspects of Hearing Impairment, (Center for Assessment and Demographic Studies: Gallaudet University), 1987, p.1.
2. National Center for Health Statistics, Data from the National Health Survey, Series 10, No. 160, Tables 62, 78, 1987.
3. 1986 Mass. Population-5,280,000 U.S. Dept. of Commerce, Bureau of the Census, Data from the Current Population Reports, State Population and Household Estimates, With Age, Sex, and Components of Change: 1981-1986, Series P-25, No. 1010, Table 6, 1986.
4. Massachusetts Commission for the Deaf and Hard of Hearing (MCDHH), Estimated Hearing Impaired Population (All Ages) in Massachusetts, Oct. 1985.
5. MCDHH estimates total deaf equal to 29,225; total hearing impaired equals 292,740
6. Tom Allen, Center for Assessment and Demographic Studies, Gallaudet Research Institute, Washington, D.C., (Phone conversation, May 1988). This decibel level is the average detected decibel level at various frequencies.
7. U.S. Congress, Office of Technology Assessment, Hearing Impairment and Elderly People: A Background Paper, OTA-BP-BA-30 (Washington, D.C.: U.S. Government Printing Office, May 1986), p. 3.
8. Arthur Dramin, Massachusetts Executive Office of Elder Affairs (EOEA), (Phone conversation, May 1988).
9. Future prevalency rates are difficult to estimate.
10. For instance, approximately 22,000 elders residing in nursing homes require skilled nursing care and consequently will probably not require mass transportation systems.
Source: Sheila Martin, Supervisor, State Long-Term Care Ombudsman Program (EOEA), (Phone conversation, May 1988).
11. Boston Primary Metropolitan Statistical Area Population, 1986 Estimate: 2,824,200, U.S. Bureau of the Census, Boston Regional Office, (Phone conversation, May 1988).
12. We considered the possibility of different ridership patterns for the hearing impaired as compared to the general population. However, given our broad definition of the hearing impaired population, we believe that the differences are too slight to be significant for the purposes of this report.
13. No specific number of the owners of FM and Infrared receivers is available, but probably even fewer people own receivers than the 20% of the hearing impaired population that wears hearing aids.

14. The Siemens Company, (Phone conversation, May 1988)
15. William Sound Company, (Phone conversation, May 1988)
16. This is estimated using the fact that 20% of the hearing impaired population wears hearing aids and of that 20%, another 20% wears behind the ear hearing aids with T switches. Thus $.20 \times .20$ equals .04 or 4%.
Source: Preben Brunbed, Oticon Company, (Phone conversation, May 1988).
17. James Peringer, William Sound Company, (Phone conversation, May 1988).
18. Metrovision Video Monitor Information packet.
19. Hi-Tech information packet.
20. Mr. Albert Babinicz, President of Metrovision of North America, Inc. (Phone conversation, May 1988).
21. Dave Sonnenfeld, Southern California Rapid Transit, (Phone conversation, May 1988).
22. Harley Goldstrom, BART, (Phone conversation, May 1988).
23. Bob Fix, BART, (Phone conversation, May 1988).
24. Trung Do, Vers Digital Technology, (Phone conversation, May 1988).
25. Jim Dutter, Silent Radio, (Phone conversation, May 1988).
26. Al Sonnenstrahl, Telecommunications for the Deaf, Inc., (Phone conversation, May 1988).
27. Dr. Katherine Seelman, MCDHH, (personal conversation, May 1988).
28. Dr. Katherine Seelman, MCDHH, (personal conversation, May 1988).
29. Governor's Commission on Accessible Transportation, Access to Transportation: The Road to Opportunity, Position Paper Six: Accessible Transportation: Current Law, Policy, and Enforcement, April 1987.
30. Massachusetts Bay Transportation Authority (MBTA), MBTA Policy Statement on Special Needs Accessibility, prepared by the MBTA Office for Special Needs, June 3, 1987.
31. Massport, Pathways: Helping Elderly and Disabled People Get Around Logan Airport, prepared by Adaptive Environments Center, July 1987.
32. Lucy Shorter, MBTA Pass Program, (phone conversation, May 1988).

33. The London and Bristol bus notification program was brought to our attention by Marjorie Boone of Self-Help for the Hard of Hearing, (personal letter, May 1988).
34. Bill Madden, MBTA Office of Special Needs, (phone conversation, May 1988).
35. The suggestion of paging monitors was made to us by Elaine Ostroff of Adaptive Environments Center, (phone conversation, May 1988).

TABLE 1
ESTIMATED HEARING IMPAIRED POPULATION IN MASSACHUSETTS
BY AGE, 1986

	Total Population (Massachusetts, 1986) (1)	Percent of Total by Age	Percent of Age Group Hearing Impaired (U.S.) (2)	Estimate of Hearing Impaired (Mass.)
Under 18	1,341,000	23.00%	1.91%	25,613
18-44	2,578,000	44.20%	4.98%	128,384
45-64	1,118,000	19.20%	15.89%	177,650
65-74	458,000	7.90%	26.19%	119,950
75+	336,000	5.80%	34.68%	116,524

Sources: [1] Massachusetts Population

U.S. Department of Commerce, Bureau of the Census, Data from the Current Population Reports, State Population and Household Estimates, With Age, Sex, and Components of Change: 1981-1986, Series P-25, No. 1010, Table 6, 1986.

[2] Prevalency Estimates for Hearing Impairments in U.S. National Center for Health Statistics, Data from the National Health Survey, Series 10, No. 160, Tables 62, 78, 1987.

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TABLE 2

SELECTED HANDICAPPED POPULATIONS BY LEVEL OF IMPAIRMENT
FOR MASSACHUSETTS

	Hearing Impaired	Visually Impaired	Mobility Impaired
Estimate of Population Size			
High	528,000 (a)	468,000 (b)	655,000 (c)
Medium	293,000 (d)	100,000 (e)	146,000 (f)
Low	(Deaf) 29,000 (g)	(Blind) 27,000 (h)	(wheelchair users) 40,000 (i)

Methods of Estimation:

- (a) Derived by applying the national prevalency rate of hearing impairments in the U.S. (9.07% in 1985) to the estimated population of Massachusetts in 1986 (5,832,000). Hearing impairments include all people reporting any type of hearing problem. Prevalency estimates in National Health Survey are only for civilian noninstitutionalized population. Figures for (a), (b), and (c) are derived by applying prevalency rates to total population.

Sources:

[1] Prevalency estimates for hearing impairments in U.S.--National Center for Health Statistics, Data from the National Health Survey, Series 10, No. 160, Table 57, 1985.

[2] Population estimate for Massachusetts, 1986--U.S. Department of Commerce, Bureau of the Census, Data from the Current Population Reports, State Population and Household Estimates, With Age, Sex, and Components of Change: 1981-1986, Series P-25, No. 1010, Table 6, 1986.

- (b) Derived by applying the combined national prevalency rates for visual impairment, color blindness, cataracts, and glaucoma as defined by the National Health Survey (8.02%) to Massachusetts population.

Source: Same as (a).

- (c) Derived by applying the combined national prevalency rates (11.23%) for absence of extremities, paralysis of extremities, and deformity or orthopedic impairment (back and lower extremities, upper extremities not included) to Massachusetts Population.

Source: Same as (a).

- (d) Estimate of the hearing impaired population (deaf and hard of hearing) in Massachusetts, 1985.

Source: Massachusetts Commission for the Deaf and Hard of Hearing.

- (e) Estimate of the blind and visually impaired population in Massachusetts.
Source: Vision Foundation, Watertown, Massachusetts (phone conversation with Fran Weiss, May 1988).
- (f) Estimate of those individuals in Massachusetts with orthopedic impairments including absence of extremities, paralysis, cerebral palsy, and deformity of limb, 1980.
Source: Richard E. Lung, Massachusetts Handicapped Statistics (Cambridge Systematics, Inc.: April 1985).
- (g) Estimate of the deaf population in Massachusetts, 1985.
Source: Massachusetts Commission for the Deaf and Hard of Hearing.
- (h) Estimate of the legally blind population in Massachusetts, 1988.
Source: Registration figures from the Massachusetts Commission for the Blind.
- (i) Estimate of the number of individuals in Massachusetts who use wheelchairs. This figure may be as large as 2% of the general population.
Source: Denise Karuth, Massachusetts Office of Handicapped Affairs (phone conversation, May 1988).

TABLE 3

DAILY HEARING IMPAIRED USERS OF THE MBTA SYSTEM

Riders Per Day on MBTA System

Total Daily Ridership	852,193 (a)
Estimates of Hearing Impaired Population As % of MBTA riders (b)	
High Estimate--9.1%	77,549 (all hearing impaired)
Medium Estimate--5.0%	42,610
Low Estimate--0.49%	4,176 (only legally deaf)

Notes:

- (a) Total Daily Ridership is derived by adding average daily ridership on the rapid transit lines (396,674) plus average daily ridership on the surface transit lines (455,519). Linked trips (including both a surface transit and rapid transit component) are not taken into account.
Source: Mary Ellen Sullivan and Alicia Powell Wilson, 1985 MBTA Fare-Mix Sampling Program: Analysis and Documentation, CTPS Technical Report 57, January 1987.
- (b) Here, we make the assumption that MBTA riders have the same prevalency rates for hearing impairment as the general Massachusetts. Percentages are calculated by dividing the hearing impaired population estimates from Table 2 by the total Massachusetts population in 1986 (5,832,000)

TABLE 4

DAILY HEARING IMPAIRED USERS OF LOGAN AIRPORT

 Passengers Per Day at Logan Airport
 (arrivals and departures)

Total Average Daily Ridership	63,789 (a)
Estimates of Hearing Impaired Population as % of Airport passengers (b)	
High Estimate--9.1%	5,805 (all hearing impaired)
Medium Estimate--5.0%	3,190
Low Estimate--0.49%	313 (only legally deaf)

Notes:

- (a) Total Daily ridership is derived by dividing the total year 1987 passenger count of 23,283,047 by 365.
Source: Massport Aviation Office, Boston Massachusetts (phone conversation with (Andrew Tsihlis, May 1988).
- (b) Here, we make the assumption that the passenger population at Logan Airport has the same prevalency rate for hearing impairment as that of the Massachusetts population. This is somewhat imprecise since many of the airport passengers will be from other locations. Percentages are calculated by dividing the hearing impaired population estimates from Table 2 by the total Massachusetts population in 1986 (5,832,000).

APPENDIX 1

PRESENT PRACTICES OF SELECTED TRANSIT AUTHORITIES RELATING TO THE DEAF AND HARD OF HEARING

	FM/ Infrared Loops (1)		Monitors	Readerboards	TDD #s (2)	TDD unit (3)	ST (4)
Austin, TX: Capital Metro	NO	NO	NO	N/A	YES	3+	YES
Baltimore, MD: MTA	NO	NO	NO	NO	YES	3	SOME
Boston, MA: MBTA	NO	NO	TESTING 1	TESTING 1	YES	7	ANNUAL
Brockton, MA: BAT	NO	NO	NO	NO	N/A	N/A	OPTIONAL
Chicago, IL: Chicago Transit	NO	NO	METROVISION 10 STATIONS	NO	YES	NO	NO
Denver, CO: Regional Trans.	NO	NO	NO	NO	YES	YES	YES
Detroit, MI: Dept. of Trans.	NO	NO	NO	NO	YES	NO	YES
Los Angeles, CA: RTD	NO	NO	HI-TECH 2 MONITORS	NO	YES	N/A	N/A
Madison, WI: Madison Metro	NO	NO	NO	NO	YES	N/A	NO
Miami, FL: Metro/Dade	NO	NO	NO	YES	YES	NO	YES
New York, NY: MTA	NO	NO	NO	MOTION MESSAGE 300 BOARDS	YES	NO	NEW HIRES
Oakland, CA: BART	NO	NO	NO	STEWART WARNER 34 STATIONS	YES	2	YES
Philadelphia, PA: SEPTA	NO	NO	METROVISION	NO	YES	NO	YES
Pittsburgh, PA: PATransit	NO	NO	NO	NO	YES	NO	RETRAIN

PRESENT PRACTICES OF SELECTED TRANSIT AUTHORITIES
RELATING TO THE DEAF AND HARD OF HEARING
(continued)

	FM/ Infrared Loops (1)		Monitors	Readerboards	TDD #s (2)	TDD unit (3)	ST (4)

Sacramento, CA:							
Regional Transit	NO	NO	NO	NO	YES	NO	RETRAIN
Toronto, Canada:				VERS-DIGITAL			
TTC	NO	NO	NO	62 STATIONS	YES	NO	PERIODIC
Washington, D.C.:							
WMATA	NO	NO	NO	NO	YES	20	YES

Footnotes:

- (1) FM/Infrared: FM/Infrared amplification systems.
- (2) TDD #s: TDD numbers that people can call for general information.
- (3) TDD unit: TDD units that are available to the public for outgoing calls.
- (4) ST: Sensitivity Training

APPENDIX 2

PRESENT PRACTICES OF SELECTED AIRPORTS RELATING TO THE DEAF AND HARD OF HEARING

	FM/ Infrared (1)	Loops	Paging Monitors (2)	Readerboards	TDD #s (3)	TDD unit (4)	ST (5)
Atlanta, GA: Hartsfield	NO	NO	NO	NO	YES	YES	NO
Boston, MA: Logan	NO	NO	NO	NO	NO	1	NO
Chicago, IL: O'Hare	NO	NO	NO	NO	NO	5	NO
Dallas, TX: Dallas/Fort Worth	NO	NO	NO	NO	YES	4	NO
Los Angeles, CA: Los Angeles	NO	NO	NO	NO	YES	9	NO
New York, NY: Kennedy	NO	NO	NO	NO	NO	2 PERIODIC	
Washington, D.C.: National	NO	NO	NO	NO	YES	1	YES

Footnotes:

- (1) FM/Infrared: FM/Infrared amplification systems.
- (2) Paging monitors: Monitors on which paging announcements are posted.
- (3) TDD #s: TDD numbers that people can call for general information
Paging monitors: Monitors on which paging announcements are posted.
- (4) TDD unit: TDD units that are available to the public for outgoing calls.
- (5) ST: Sensitivity Training

APPENDIX 3

SELECTED NAMES AND ADDRESSES OF PEOPLE AND COMPANIES CONTACTED

KEY PEOPLE:

ROBERT ASHBY

Deputy Assistant General Counsel
for Regulation and Enforcement
U.S. Dept. of Transportation
400 Seventh St., Room 10424 SW
Washington, D.C. 20590
202/ 366-9306

DAVID HOTCHKISS

Center for Assessment and Demographic Studies
Gallaudet University
800 Florida Avenue NE
Washington, D.C. 20002
202/651-5575

DENISE KARUTH

Office of Handicapped Affairs
1 Ashburton Place, Rm 1305
Boston, MA 02108
617/727-7440

DR. TOBY PEARLSTEIN

Chief Librarian and Archivist
State Transportation Library
10 Park Plaza
Boston, MA 02116
617/973-8000

BOB REYES

Planner
Massport
10 Park Plaza
Boston, MA 02116

DR. KATHERINE SEELMAN

Massachusetts Commission for the Deaf and Hard of Hearing
600 Washington St., Suite 600
Boston, MA 02111
617/727-5106 (TDD/Voice)

ANDREW TSIHLIS

Massport Aviation/Planning
Old Tower Building, Third Floor
Logan International Airport
East Boston, MA 02128
617/561-1643

DR. IRA WINAKUR
Center for Economic Understanding
5010 Nicholson Lane, Suite F
Rockville, MD 20852
301/231-8018

ORGANIZATIONS

ADAPTIVE ENVIRONMENTS CENTER
Massachusetts College of Art
621 Huntington Ave.
Boston, MA 02185

ALEXANDER GRAHAM BELL ASSOCIATION FOR THE DEAF
1537 35th St, NW
Washington, D.C. 20007
202/337-5220

CENTRAL TRANSPORTATION PLANNING STAFF
State Transportation Building
10 Park Plaza, Suite 2150
Boston, MA 02116
617/973-7119

MASSACHUSETTS BAY TRANSIT AUTHORITY
OFFICE OF SPECIAL NEEDS
617/722-5123 or 617/722-5415 (TDD)

NATIONAL ASSOCIATION FOR THE DEAF
814 Thayer Ave.
Silver Spring, MD 20910
301/587-1788

NATIONAL CENTER FOR HEALTH STATISTICS
3700 E. West Highway
Hyattsville, MD 20782
301/436-8500

MASSACHUSETTS ARCHITECTURAL ACCESS BOARD
1 Ashburton Place, Rm. 1310
Boston, MA 02108
617/727-0660

SELF HELP FOR THE HARD OF HEARING
780 Wisconsin Ave.
Bethesda, MD 20814
301/657-2248



STEWART WARNER COMPANY

130 North Costner Ave.

Chicago, IL

312/292-3000

Contact: George Burns

Manufactured the readerboards for San Francisco's BART. The company no longer manufactures the boards, but it is doing consulting work on BART's proposed renovation of the readerboards.

WHITEWAY SIGN

1317 N. Clybourn

Chicago, IL 60610

312/642-6580

Contact: Russ Andrews

Mr. Andrews designed the hardware and software used in the San Francisco BART readerboard system.

MANUFACTURERS OF VIDEO MONITOR SYSTEMS:

METROVISION

600 Erie Place, Suite 106

Syracuse, NY 13204

315/476-5330

Contact: Albert Babinicz

Metrovision places video screens in transit systems for advertising and information purposes.

TRADE JOURNALS AND ASSOCIATIONS:

HEARING INDUSTRIES ASSOCIATION

Washington, D.C.

202/833-1411

Contact: Carol Rogin

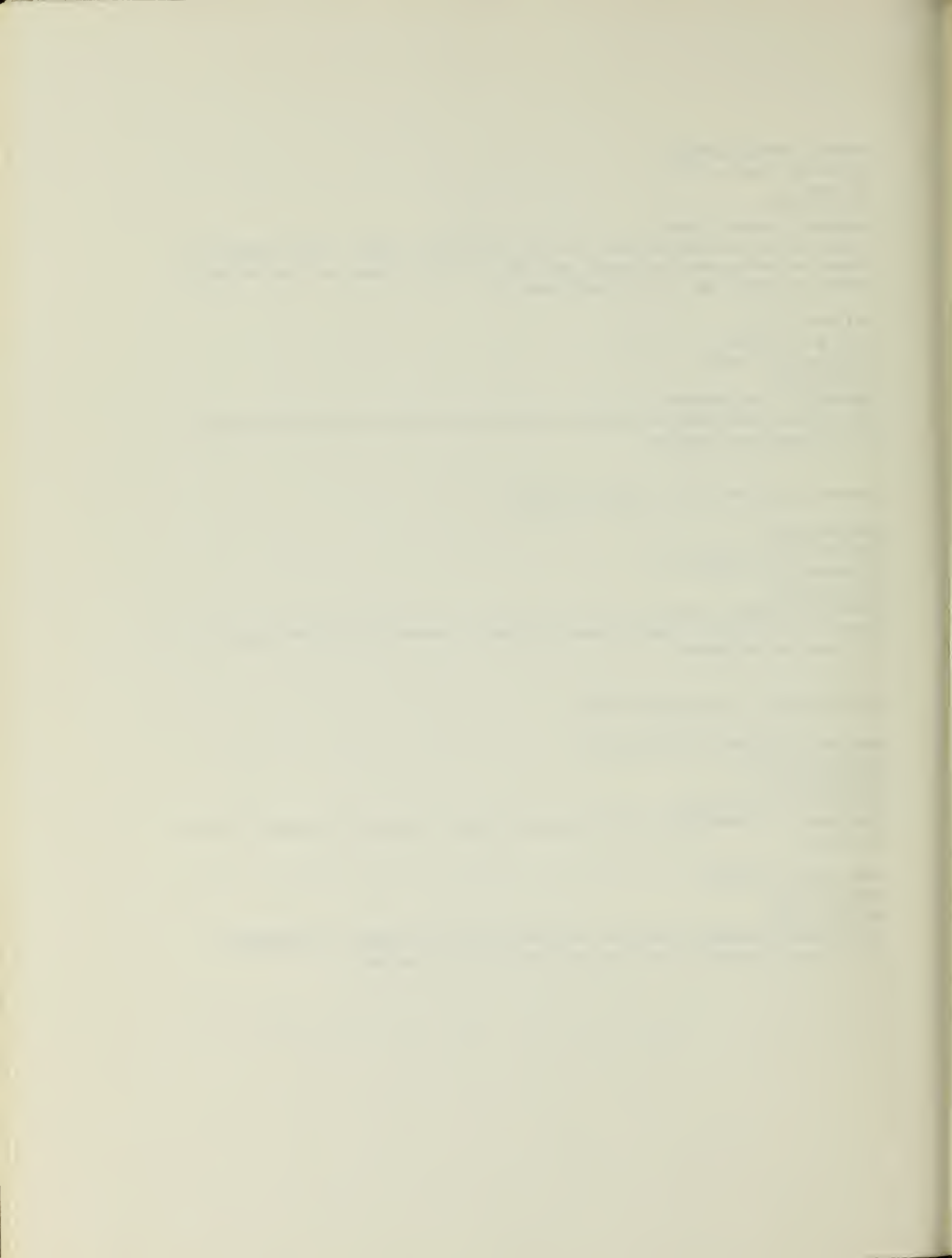
The Hearing Industries Association does market research on behalf of the industry.

THE HEARING JOURNAL

Maynard, MA

617/897-5552

The Hearing Journal publishes a directory every December of companies which handle products for the deaf and hard of hearing.



AIRPORTS

HARTSFIELD INTERNATIONAL AIRPORT

Atlanta, GA 30320

404/766-4511

O'HARE INTERNATIONAL AIRPORT

312/686-2304

Contact: Susan Malley

DALLAS/FORT WORTH REGIONAL AIRPORT

214/574-8888

Contact: J. Carranza

LOS ANGELES INTERNATIONAL AIRPORT

213/646-2270

CONTACT: Francis Smith

JOHN F. KENNEDY INTERNATIONAL AIRPORT

718/656-4870

Contact: Linda Miller

WASHINGTON D.C. NATIONAL AIRPORT

703/684-3472

Contact: Ann Ingram

TRANSIT

CAPITAL METROPOLITAN TRANSPORTATION AUTHORITY

1005 Congress Ave.

P.O. Box 1943

Austin, TX 78767

512/476-7400

MASS TRANSIT ADMINISTRATION OF MARYLAND

300 West Lexington St.

Baltimore, MD 21201

301/333-4639

Contact: Angela Martin

Brockton Area Transit Authority

7 Crescent St.

Brockton, MA 02401

617/588-2240

CHICAGO TRANSIT AUTHORITY

Merchandise Mart Plaza

P.O. Box 3555

Chicago, IL 60654

312/664-7200

Contact: Bill Baxa



REGIONAL TRANSPORTATION DISTRICT

1600 Blake St.
Denver, CO 80202
303/628-9000

CITY OF DETROIT DEPARTMENT OF TRANSPORTATION

1301 East Warren Ave.
Detroit, MI 48207
313/833-7693
Contact: Bob Doetsch

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT

Los Angeles, CA 90013
213/972-6000

MADISON METRO

1101 E. Washington Ave.
Madison, WI 53703
608/266-4904

METROPOLITAN DADE COUNTY TRANSIT AGENCY

111 NW 1st St., Suite 910
Miami, FL 33128
305/375-5000
Contact: Sharon Weintraub

METROPOLITAN TRANSPORTATION AUTHORITY

347 Madison Ave.
New York, NY 10017
212/878-7469
Contact: Douglas Sussman

SAN FRANCISCO BAY AREA RAPID TRANSIT DISTRICT

P.O. Box 12688
800 Madison St.
Oakland, CA 94604-2688
415/464-6000
Contact: Harley Goldstrom

SOUTHEASTERN PENNSYLVANIA TRANSPORTATION AUTHORITY

130 South 9th St.
The Edison Bldg.
Philadelphia, PA 19107
215/574-7300
Contact: Frank Friel

PORT AUTHORITY OF ALLEGHANY COUNTY

2235 Beaver Ave.
Pittsburgh, PA 15233
412/237-7300
Contact: B.J. Leber

REGIONAL TRANSIT
P.O. Box 2110
1400 29th St.
Sacramento, CA 95810
916/321-2800

TORONTO TRANSIT COMMISSION
1900 Yonge St.
Toronto, Ontario
416/393-4000
Contact: R. Muetz

WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY
600 Fifth St. NW
Washington, D.C. 20001
202/962-2744
Contact: Rosalyn Simon

